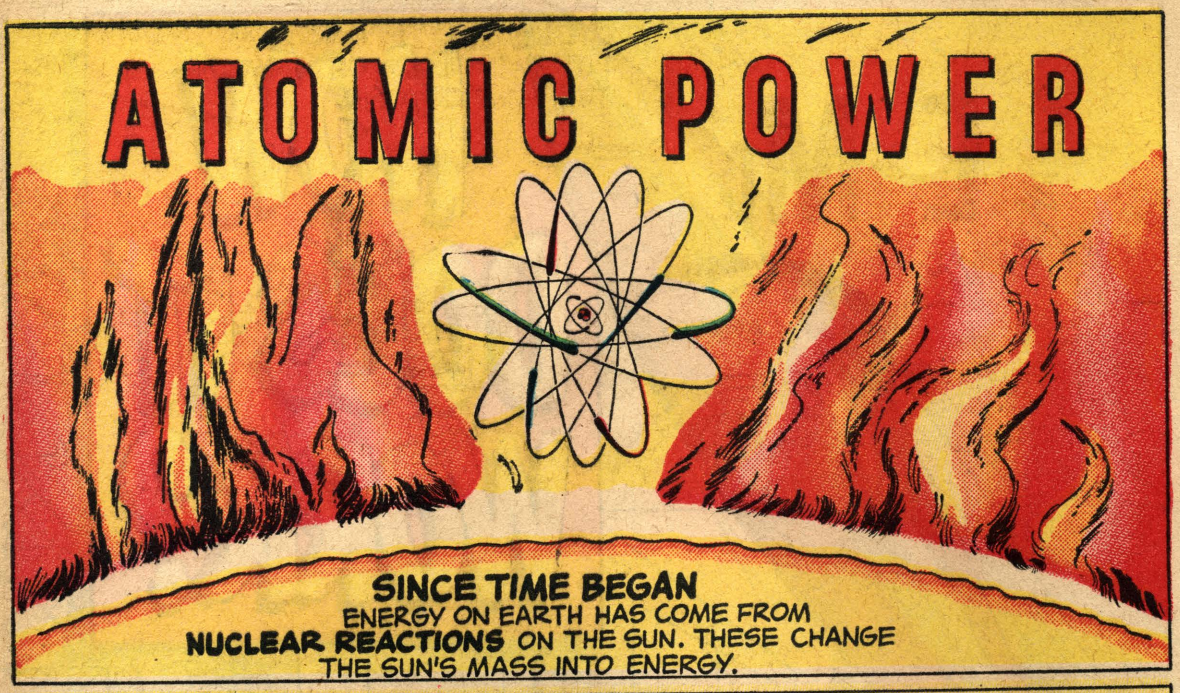
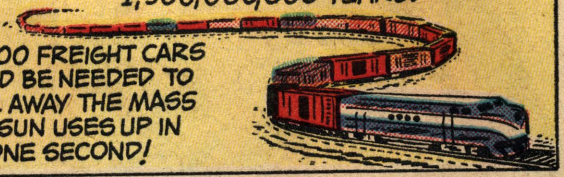
HOW DOES IT WORK?
WESTINGHOUSE
SCHOOL SERVICE
WESTINGHOUSE ELECTRIC CORPORATION
306 FOURTH AVENUE, BOX 1017
PITTSBURGH 30, PA.

ATOMIC POWER

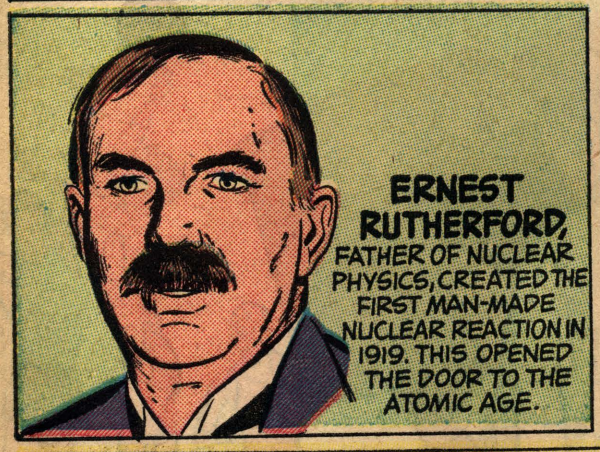


SINCE TIME BEGAN
ENERGY ON EARTH HAS COME FROM
NUCLEAR REACTIONS ON THE SUN. THESE CHANGE
THE SUN'S MASS INTO ENERGY.

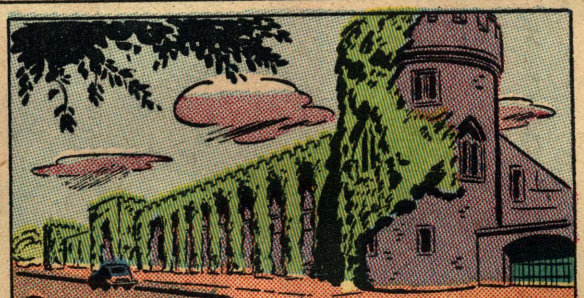
THE SUN IS SO HUGE ONLY 1/100 OF 1% OF ITS MASS WILL BE USED UP IN 1,500,000,000 YEARS.



57,000 FREIGHT CARS WOULD BE NEEDED TO HAUL AWAY THE MASS THE SUN USES UP IN ONE SECOND!



ERNEST RUTHERFORD, FATHER OF NUCLEAR PHYSICS, CREATED THE FIRST MAN-MADE NUCLEAR REACTION IN 1919. THIS OPENED THE DOOR TO THE ATOMIC AGE.

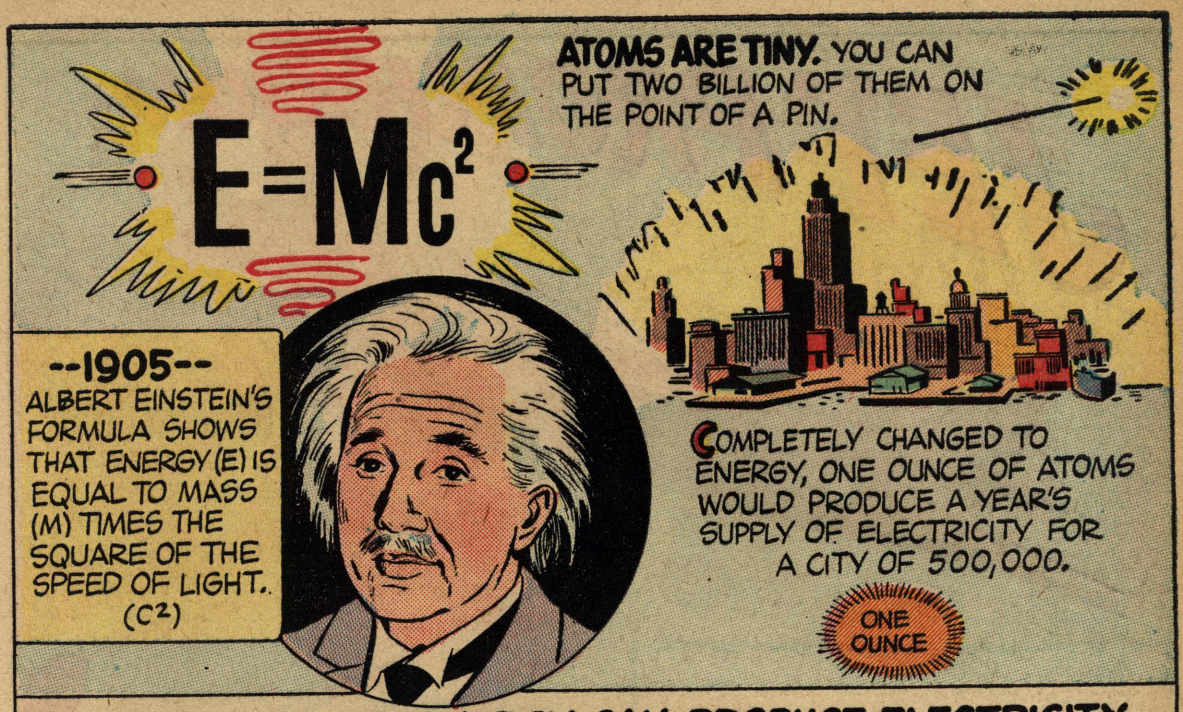


DECEMBER 2, 1942-BENEATH CHICAGO'S STAGG FIELD MEN FIRST HARNESSED THE POWER OF THE ATOM. MUCH OF THE URANIUM USED IN THIS FIRST NUCLEAR REACTOR CAME FROM THE WESTINGHOUSE LAMP RESEARCH LABORATORIES.

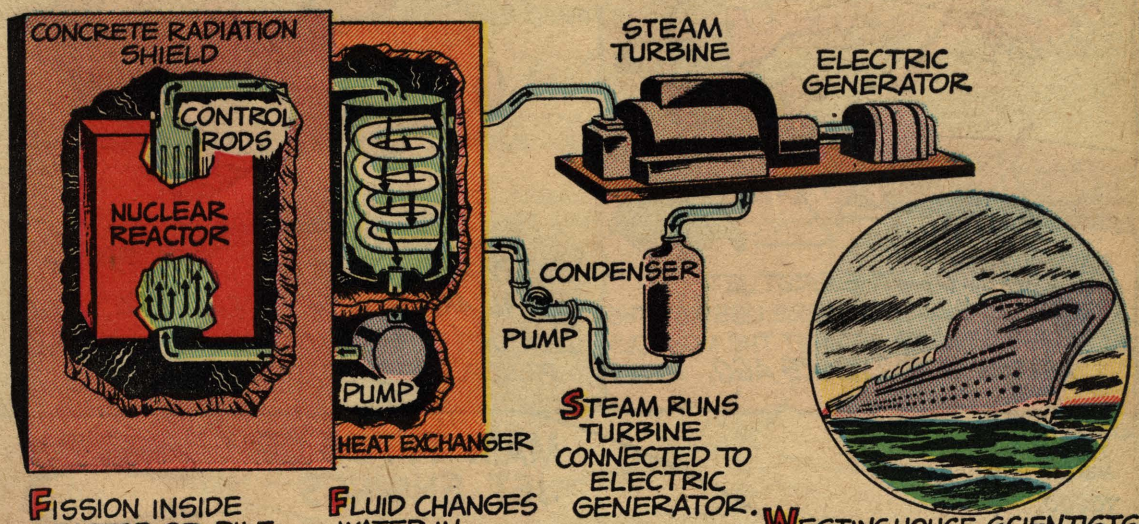
ATOMS
PROTONS AND NEUTRONS ARE IN THE NUCLEUS, AND ELECTRONS ARE IN ORBITS OUTSIDE.

WHEN STRUCK BY A FREE NEUTRON, SOME HEAVY NUCLEI SPLIT INTO TWO PARTS AND RELEASE VAST AMOUNTS OF ENERGY. IN A URANIUM PILE, THIS **NUCLEAR FISSION** CAUSES A **CHAIN REACTION**--KEY TO ATOMIC POWER.

COPYRIGHT 1960, WESTINGHOUSE ELECTRIC CORP.



HOW NUCLEAR ENERGY CAN PRODUCE ELECTRICITY



FISSION INSIDE REACTOR, OR PILE, SUPERHEATS A FLUID.

FLUID CHANGES WATER IN COILS TO STEAM.

STEAM RUNS TURBINE CONNECTED TO ELECTRIC GENERATOR.

WESTINGHOUSE SCIENTISTS AND ENGINEERS NOW ARE BUILDING A NUCLEAR REACTOR TO POWER SHIPS.

Things to DO...

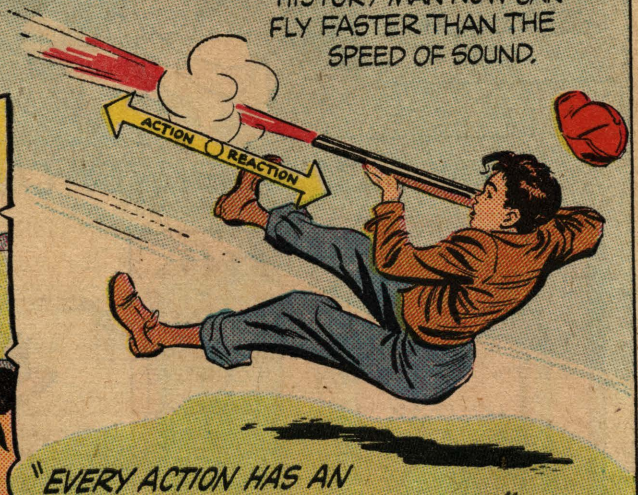
1. MAKE DIAGRAMS OR MODELS OF THE SIMPLER ATOMS, SHOWING THE PROPER NUMBER OF PROTONS, NEUTRONS, AND ELECTRONS.

2. BUILD A MODEL OF A NUCLEAR REACTOR.
3. FIND OUT WHAT YOU CAN ABOUT THE NEW "MAN-MADE" ELEMENTS. WHY ARE THEY NOT FOUND IN NATURE?
4. THERE ARE SEVERAL KINDS OF ATOM SMASHERS. LEARN WHAT THEY CAN DO AND HOW THEY ARE USED IN ATOMIC RESEARCH.
5. WHAT PRODUCTS COME FROM A URANIUM PILE? HOW ARE THEY USED IN MEDICINE AND INDUSTRY?

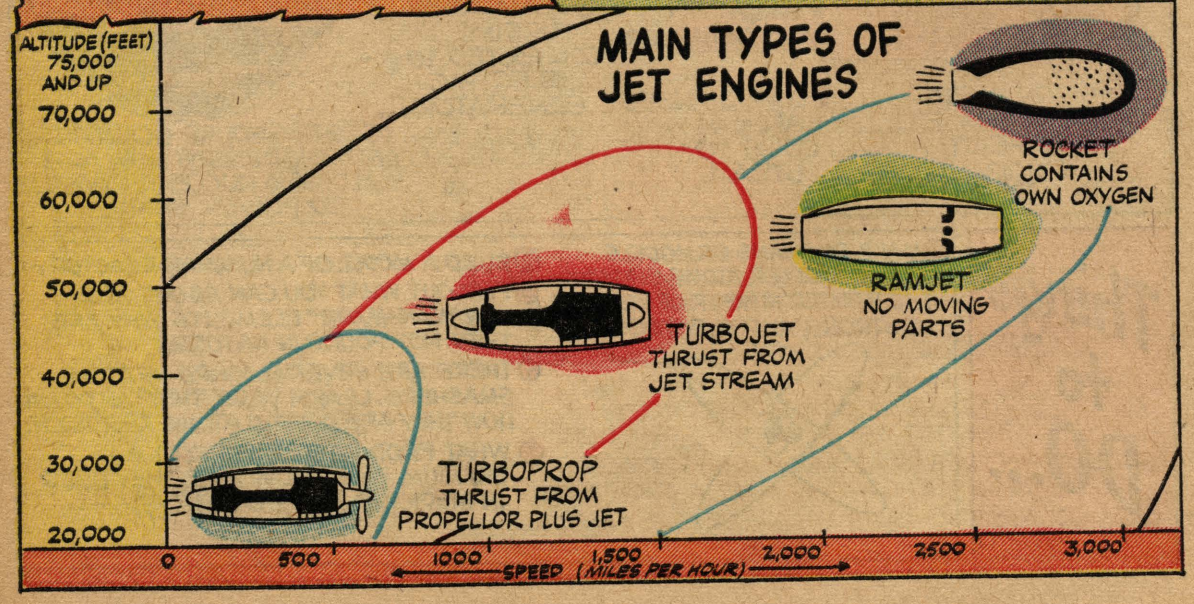
JET PROPULSION

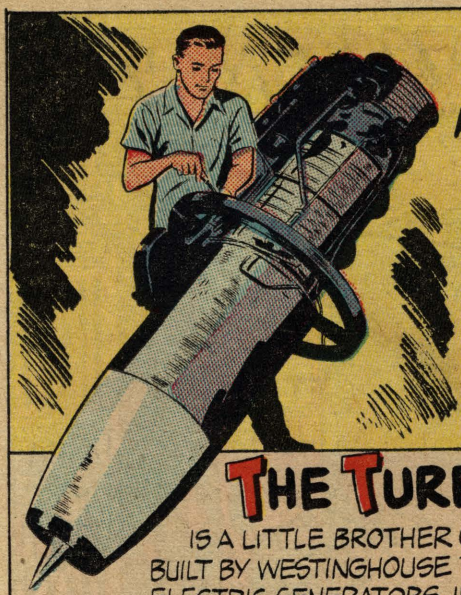
JET PROPULSION HAS OPENED A NEW ERA OF HIGH SPEED AIR TRAVEL. FOR THE FIRST TIME IN HISTORY MAN NOW CAN FLY FASTER THAN THE SPEED OF SOUND.

ROCKETS... THE FIRST JET PROPELLED DEVICES...WERE USED BY THE CHINESE IN WARS AGAINST THE MONGOLS AS LONG AS *700 YEARS AGO.*



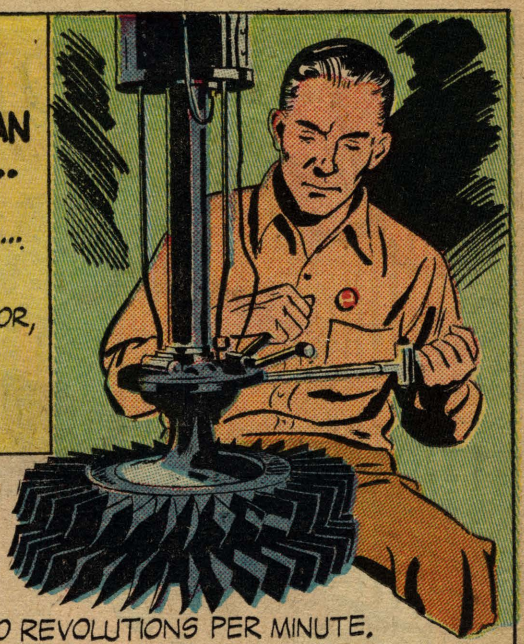
"EVERY ACTION HAS AN EQUAL AND OPPOSITE REACTION"... NEWTON'S THIRD LAW OF MOTION...IS THE BASIC PRINCIPLE OF JET PROPULSION.





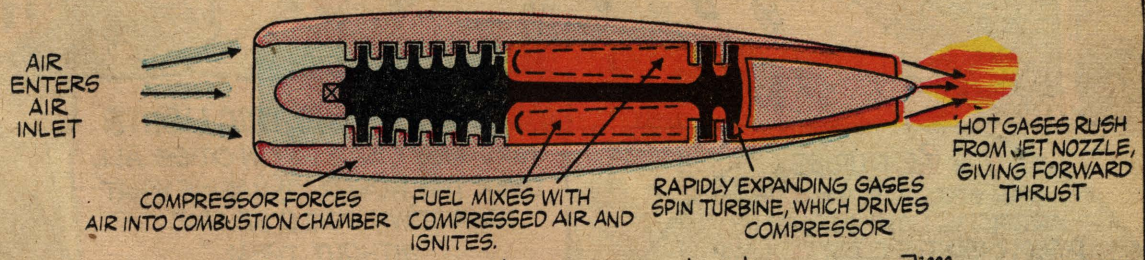
FIRST ALL-AMERICAN TURBOJET...

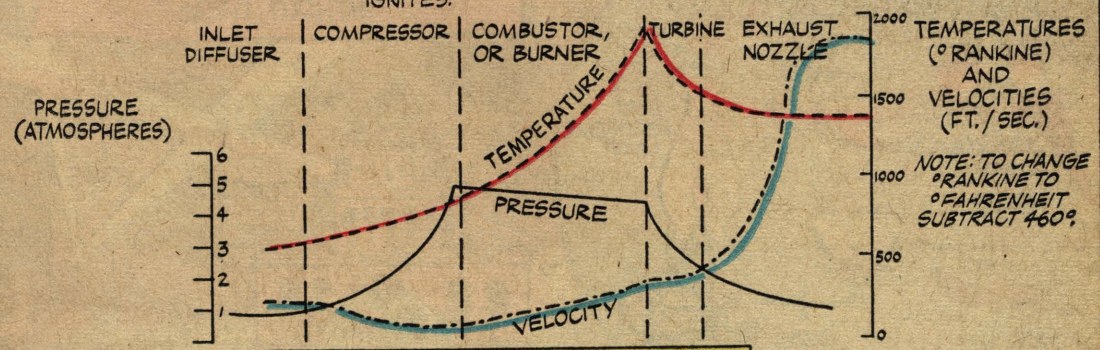
DEVELOPED BY WESTINGHOUSE... HAS THREE MAIN PARTS: AIR COMPRESSOR, COMBUSTION CHAMBER, TURBINE.



THE TURBINE

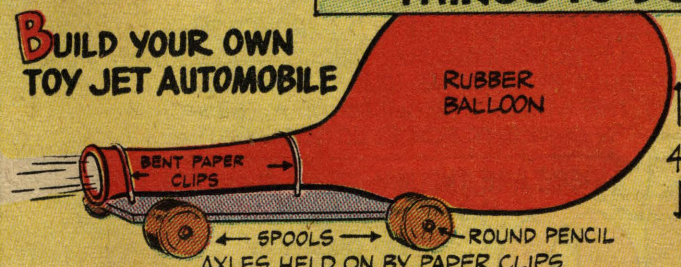
IS A LITTLE BROTHER OF TURBINES BUILT BY WESTINGHOUSE TO RUN HUGE ELECTRIC GENERATORS. IN A TURBOJET HOT GASES SPIN THE TURBINE AT 17,000 REVOLUTIONS PER MINUTE.





THINGS TO DO

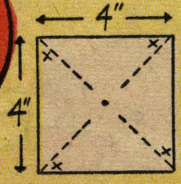
BUILD YOUR OWN TOY JET AUTOMOBILE



AXLES HELD ON BY PAPER CLIPS INSERTED THROUGH BASE AND BENT OVER.

COLLECT PICTURES OF AS MANY JET-PROPELLED AIRPLANES AS YOU CAN AND MAKE A SCRAPBOOK.

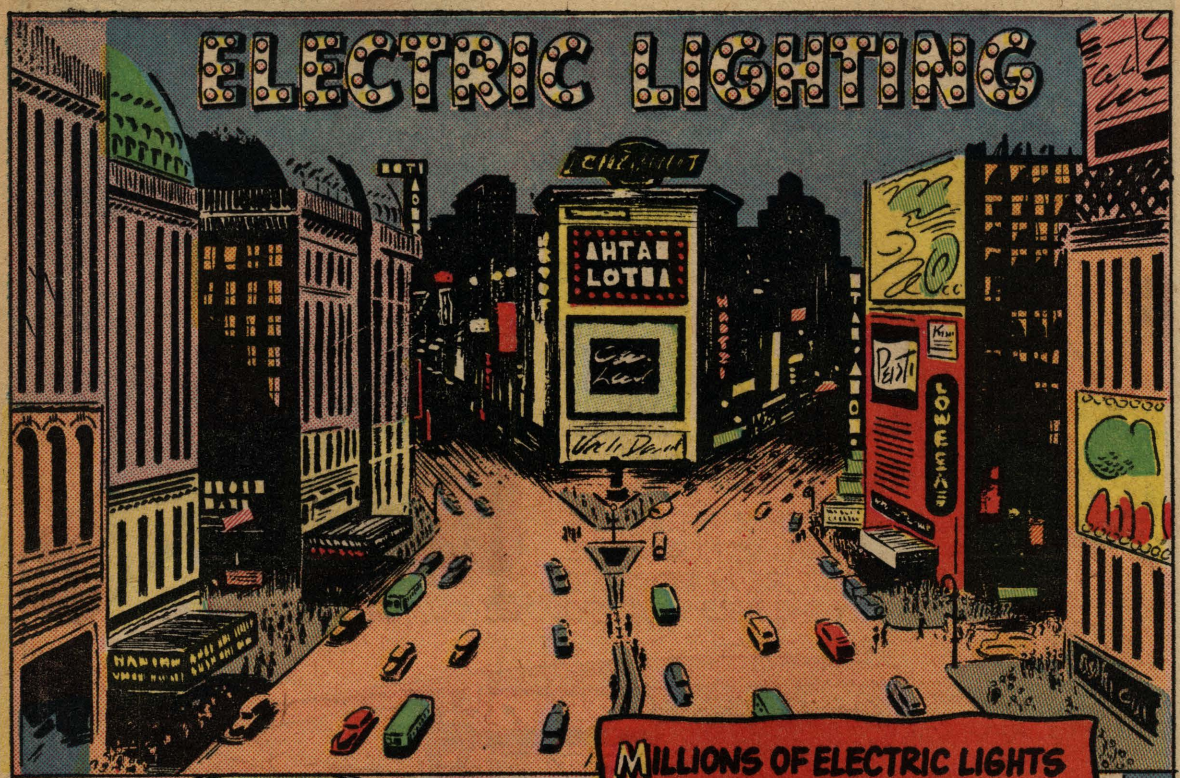
EXAMINE A ROTARY LAWN SPRINKLER, EXPLAIN HOW IT IS SIMILAR TO A JET ENGINE.



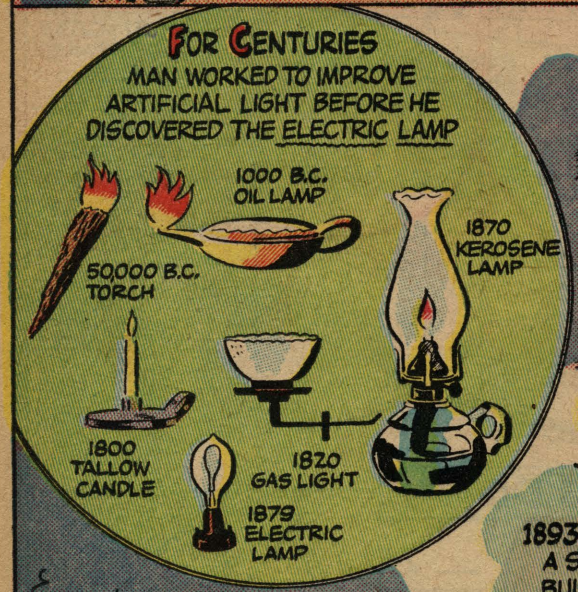
CUT ON LINES FOLD MARKED CORNERS TO CENTER AND PIN.

MAKE A PIN WHEEL OF PAPER, HOW DOES IT RESEMBLE A REAL TURBINE?

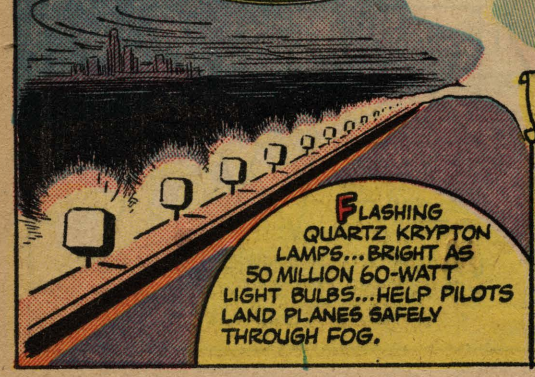
ELECTRIC LIGHTING



MILLIONS OF ELECTRIC LIGHTS TURN NIGHT INTO DAY IN CITIES ALL OVER THE WORLD. IMAGINE WHAT YOUR TOWN WOULD BE LIKE WITHOUT THEM.

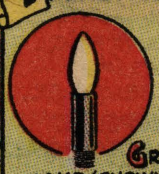


1893–COLUMBIAN WORLD EXPOSITION— A SPECTACULAR ELECTRICAL INSTALLATION, BUILT BY WESTINGHOUSE, DRAMATIZED TO THE WORLD THE VALUE OF ALTERNATING CURRENT FOR ELECTRIC LIGHTING.



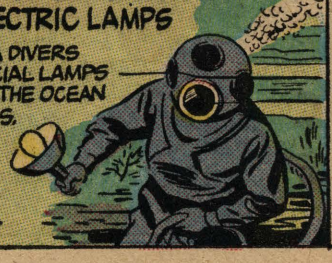
FLASHING QUARTZ KRYPTON LAMPS... BRIGHT AS 50 MILLION 60-WATT LIGHT BULBS... HELP PILOTS LAND PLANES SAFELY THROUGH FOG.

THERE ARE THOUSANDS OF DIFFERENT KINDS OF ELECTRIC LAMPS



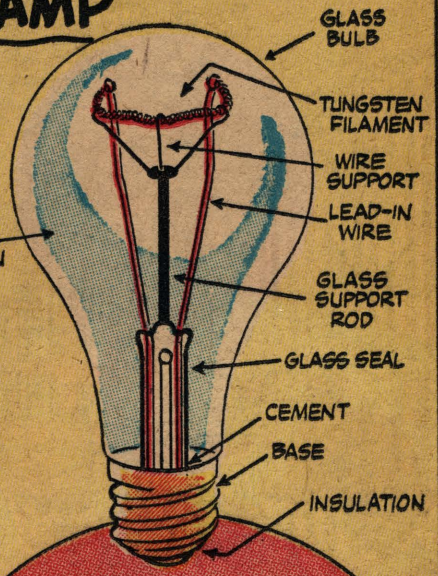
GRAIN-OF-WHEAT LAMP (SHOWN HERE, ACTUAL SIZE) IS USED BY DOCTORS TO SEE INSIDE YOUR STOMACH.

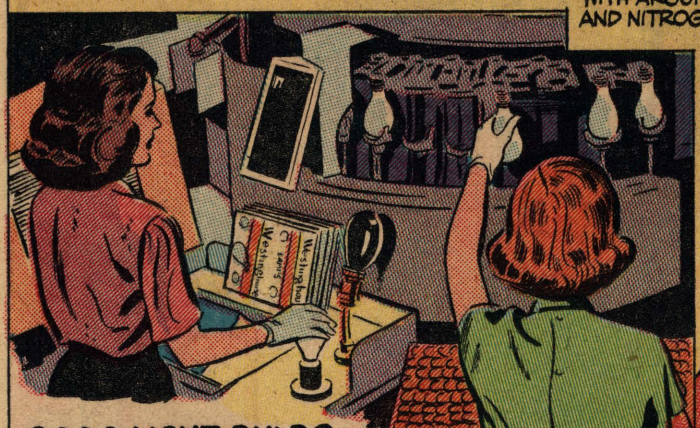
DEEP SEA DIVERS USE SPECIAL LAMPS TO LIGHT THE OCEAN FLOORS.



INCANDESCENT LAMP

TWO FEET OF TUNGSTEN WIRE, COILED, FORMS A FILAMENT THAT OPERATES AT 4530°F IN A STANDARD 60-WATT LAMP.





9000 LIGHT BULBS A DAY—

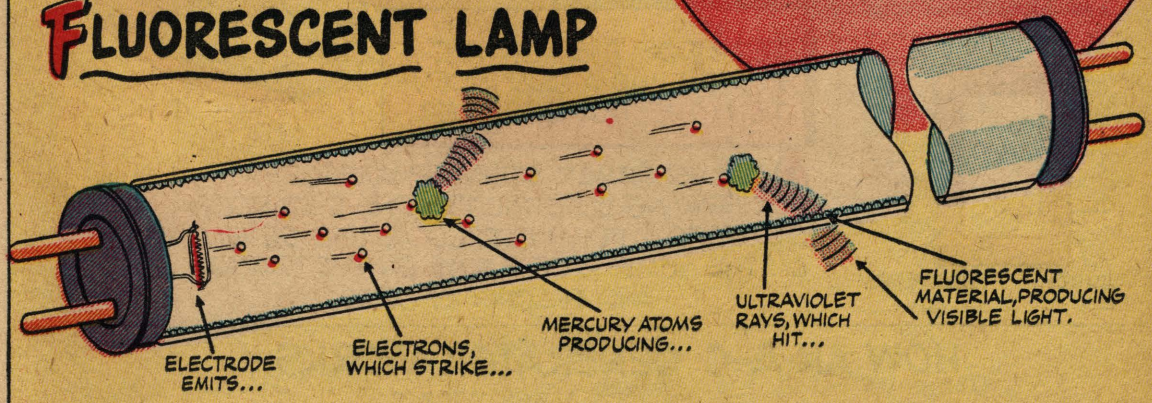
NEARLY 20 A MINUTE—

ARE TURNED OUT BY AUTOMATIC MACHINES AT THE WESTINGHOUSE LAMP DIVISION. HUNDREDS OF SUCH MACHINES ARE NEEDED TO HELP MAKE THE 2 BILLION LIGHT BULBS USED IN THE U.S. EACH YEAR.

60-WATT LAMPS

1900	1950
$1.75	12¢
37 CANDLEPOWER	66.5 CANDLEPOWER

FLUORESCENT LAMP



THINGS TO DO...

USING COPPER LEADS, HOOK A SHORT STRAND OF IRON PICTURE WIRE TO A DRY CELL. *WHY DOES THE IRON HEAT? HOW IS THIS APPLIED IN THE ELECTRIC LAMP?*

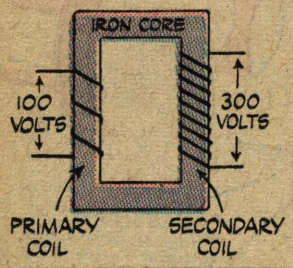
FIGURE OUT HOW MUCH IT COSTS, AT YOUR LOCAL RATES, TO RUN YOUR HOME STUDY LAMP FOR 2 HOURS EACH DAY FOR A MONTH.

FIND OUT THE RECOMMENDED LIGHTING LEVELS FOR VARIOUS AREAS IN THE HOME. DOES YOUR OWN HOME HAVE THIS AMOUNT OF LIGHT?

ELECTRIC

MARCH 20, 1886--
WILLIAM STANLEY, A WESTINGHOUSE ENGINEER, CLOSED A SWITCH, LIGHTING THE MAIN STREET OF GREAT BARRINGTON, MASS. THIS WAS THE FIRST ALTERNATING CURRENT (A-C) POWER SYSTEM IN AMERICA.

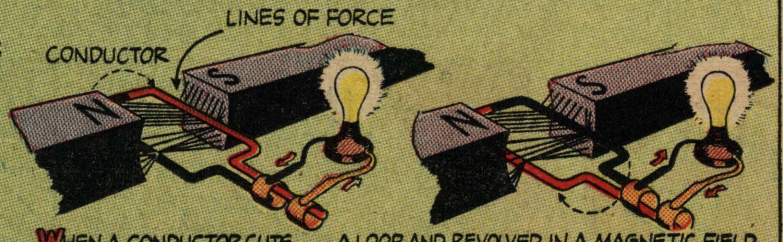
HEART OF THE NEW A-C SYSTEM WAS A NEW INVENTION- THE TRANSFORMER.



A TRANSFORMER STEPS UP VOLTAGE FOR SENDING ELECTRICITY LONG DISTANCES, OR STEPS IT DOWN FOR LOCAL USE, DEPENDING ON THE NUMBER OF TURNS ON THE PRIMARY AND SECONDARY COILS.

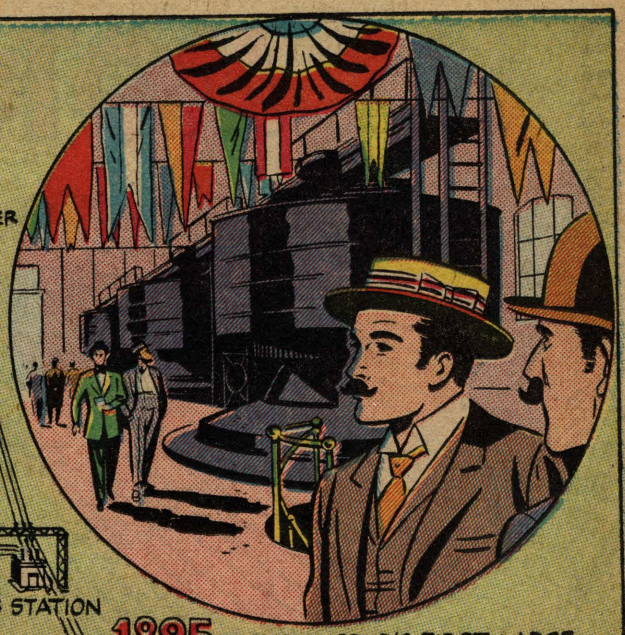
HOW AN A-C GENERATOR WORKS

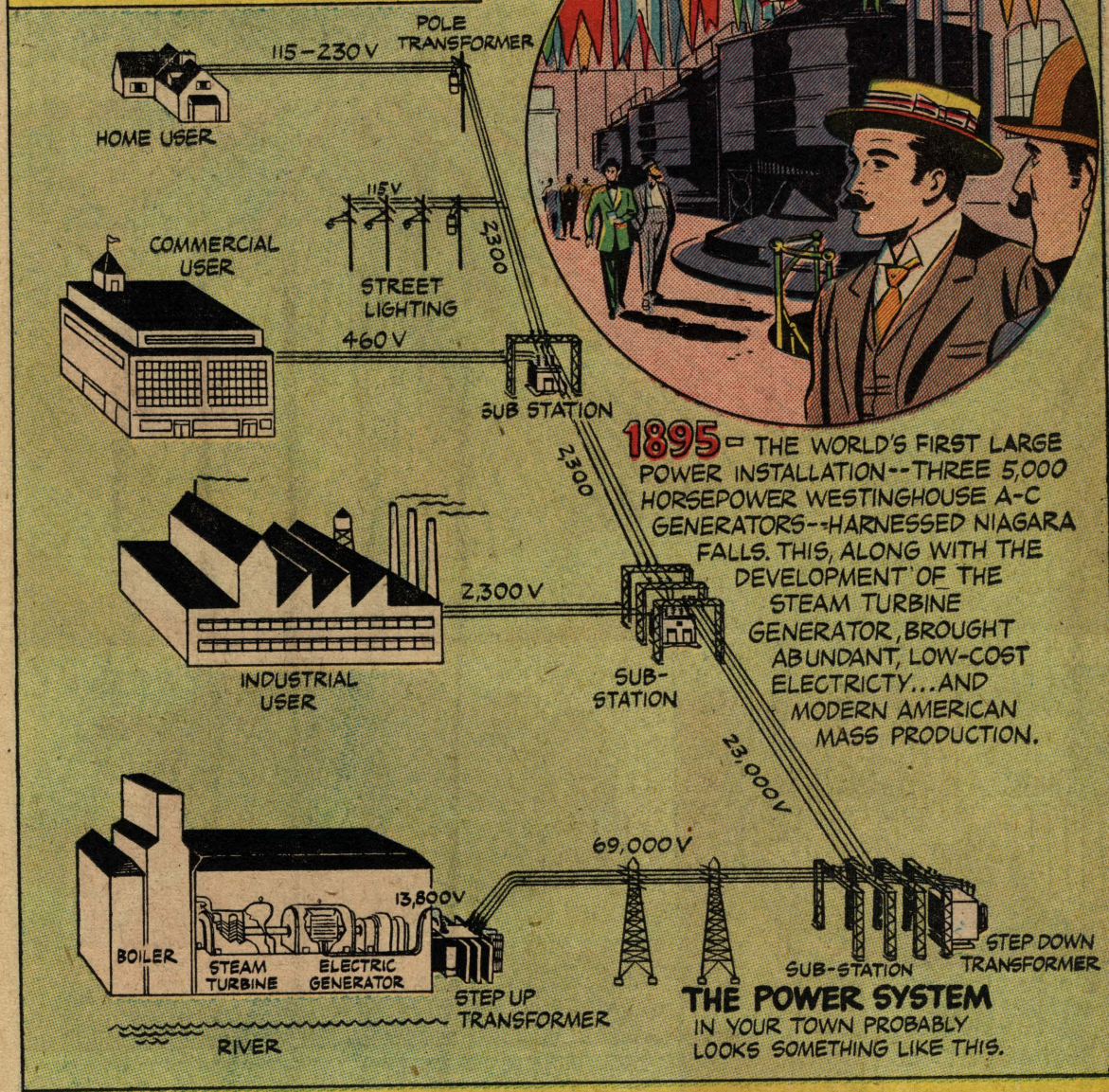
A GENERATOR CHANGES THE ENERGY OF RUSHING STEAM OR FALLING WATER INTO ELECTRICITY. A-C GENERATORS MAKE 99.85% OF THE ELECTRICITY PRODUCED IN AMERICA.



WHEN A CONDUCTOR CUTS MAGNETIC LINES OF FORCE, A VOLTAGE IS SET UP, OR INDUCED, IN IT. IF THE CONDUCTOR IS MADE INTO A LOOP AND REVOLVED IN A MAGNETIC FIELD, AN ELECTRIC CURRENT IS GENERATED. THE DIRECTION OF THE CURRENT REVERSES EACH HALF REVOLUTION, SO IT IS CALLED ALTERNATING CURRENT (A-C).

POWER



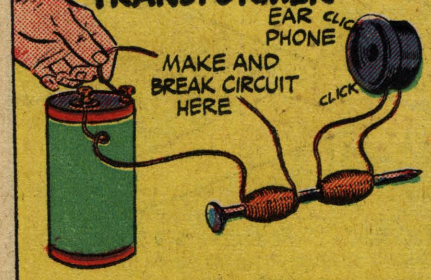


1895 – THE WORLD'S FIRST LARGE POWER INSTALLATION--THREE 5,000 HORSEPOWER WESTINGHOUSE A-C GENERATORS--HARNESSED NIAGARA FALLS. THIS, ALONG WITH THE DEVELOPMENT OF THE STEAM TURBINE GENERATOR, BROUGHT ABUNDANT, LOW-COST ELECTRICTY...AND MODERN AMERICAN MASS PRODUCTION.

THE POWER SYSTEM
IN YOUR TOWN PROBABLY LOOKS SOMETHING LIKE THIS.

THINGS TO DO

1 BUILD A NAIL TRANSFORMER

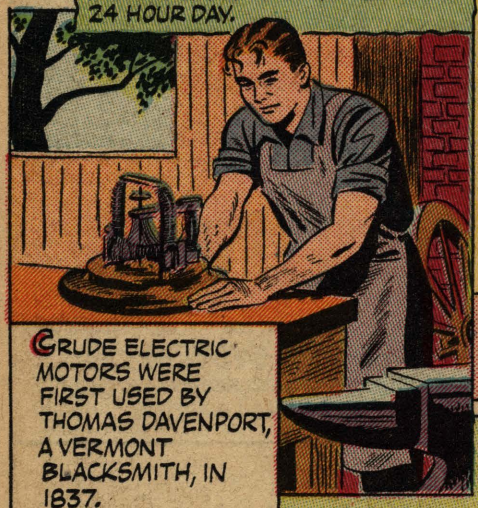


2. FIND OUT WHAT IMPORTANT THINGS ELECTRIC POWER DOES FOR YOU IN YOUR HOME?
3. MAKE A LIST OF SOME INDUSTRIES WHICH USE VAST QUANTITIES OF ELECTRIC POWER. WHAT DOES ELECTRICITY DO IN EACH CASE?
4. PREPARE A REPORT ON YOUR LOCAL GENERATING STATION. FIND OUT HOW ELECTRIC POWER IS MADE AND DISTRIBUTED IN YOUR TOWN.
5. YOUR HOME HAS EITHER TWO OR THREE ELECTRIC WIRES COMING IN FROM THE POWER LINE. CAN YOU EXPLAIN THE DIFFERENCE BETWEEN THE TWO SYSTEMS.

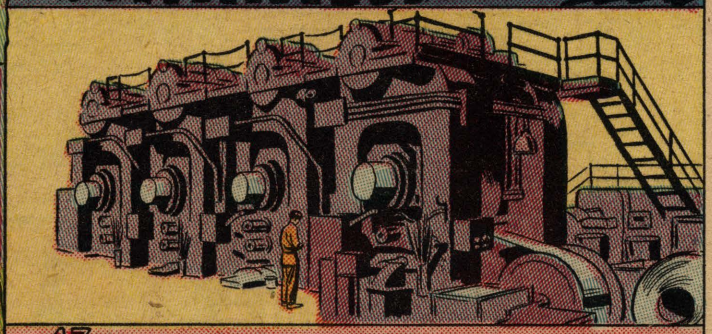
MOTORS

ELECTRIC MOTORS MAKE MAN'S LIFE EASIER AND MORE PRODUCTIVE---BY GIVING HIM MECHANICAL POWER WHEN AND WHERE HE WANTS IT.

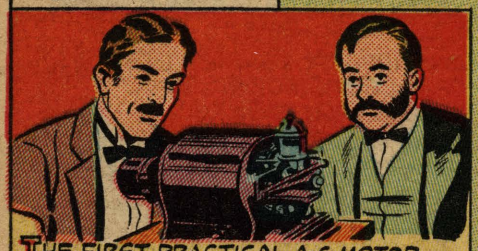
WORLD'S BIGGEST A-C MOTOR... BUILT BY WESTINGHOUSE TO HELP IRRIGATE A MILLION ACRES OF LAND IN THE FAR NORTHWEST. THE MOTOR DEVELOPS 65,000 HORSEPOWER AND WILL PUMP 800 MILLION GALLONS OF WATER IN A 24 HOUR DAY.



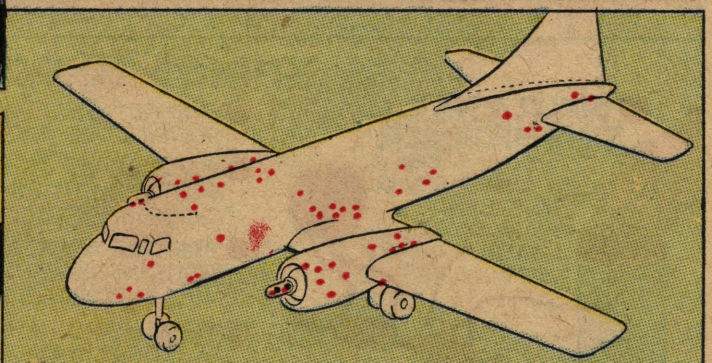
CRUDE ELECTRIC MOTORS WERE FIRST USED BY THOMAS DAVENPORT, A VERMONT BLACKSMITH, IN 1837.



13 MOTORS, WITH 11,500 HORSEPOWER, TURN OUT OVER HALF A MILE OF SHEET STEEL A MINUTE IN THIS STEEL MILL. THE AVERAGE AMERICAN WORKMAN COMMANDS 7½ HORSEPOWER TODAY.

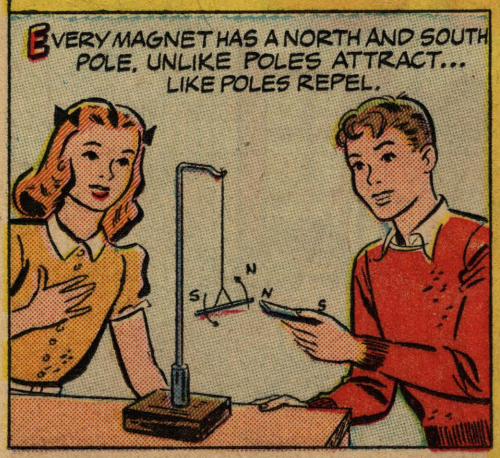


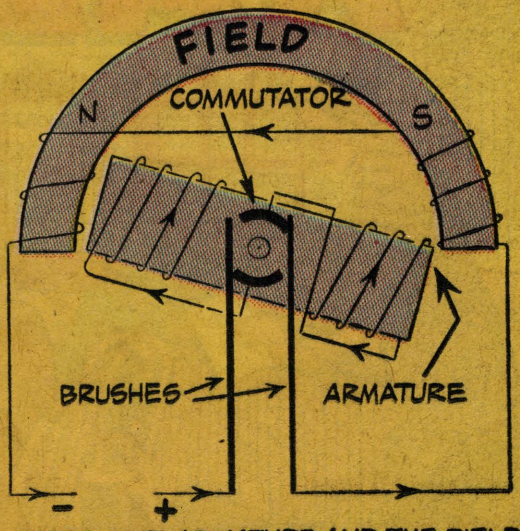
THE FIRST PRACTICAL A-C MOTOR WAS DEVELOPED AT WESTINGHOUSE BY NIKOLA TESLA IN 1888. MOST MOTORS USED TODAY ARE A-C MOTORS.



ELECTRIC MOTORS FLY. IN THIS PLANE--53 ELECTRIC MOTORS DO EVERYTHING FROM PUMPING FUEL TO CHANGING THE PITCH OF THE PROPELLORS.

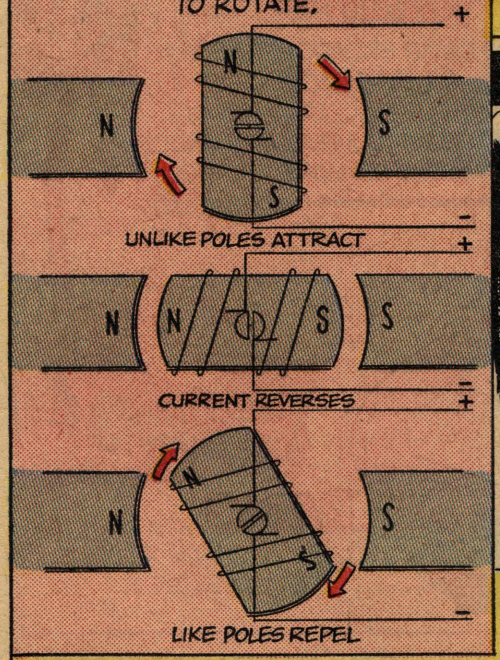
HOW AN ELECTRIC MOTOR WORKS

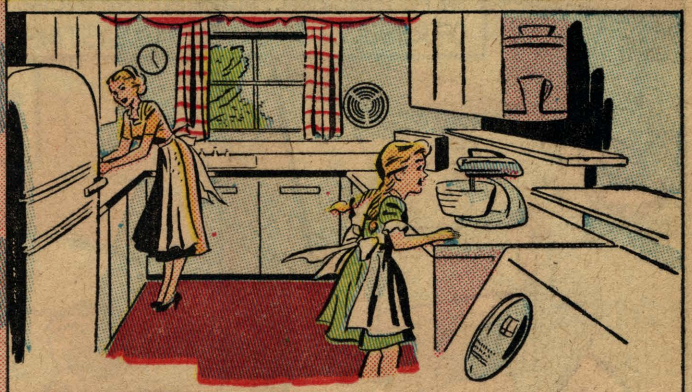




IN A MOTOR, THE ARMATURE AND THE FIELD ARE **ELECTROMAGNETS.** DIRECTION OF CURRENT IN THE COILS DETERMINES WHICH POLE IS NORTH AND WHICH IS SOUTH.

THE **COMMUTATOR** REVERSES THE CURRENT IN THE ARMATURE WHEN THE **N** POLE IS NEXT TO THE **S** POLE OF THE FIELD. THIS REVERSES THE **N** AND **S** POLES OF THE ARMATURE, CAUSING IT TO ROTATE.

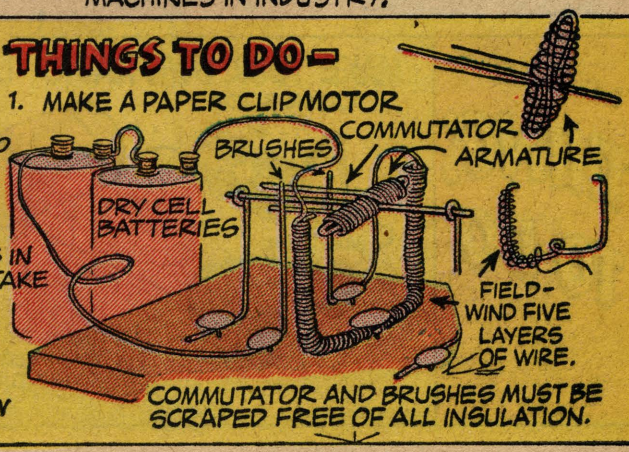




ELECTRIC MOTORS RUN MANY LABOR-SAVING DEVICES IN THE HOME. THEY ALSO RUN ELEVATORS, STREET CARS, AND THOUSANDS OF IMPORTANT MACHINES IN INDUSTRY.

THINGS TO DO—

1. MAKE A PAPER CLIP MOTOR



2. FIND OUT HOW ELECTRIC MOTORS ARE PUT TO WORK IN A STEEL MILL, PAPER MILL, OR OTHER PLANT NEAR YOU.
3. WORKING HARD, A MAN CAN DEVELOP 1/10 HORSEPOWER. ESTIMATE THE HORSEPOWER OF ALL THE ELECTRIC MOTORS IN YOUR HOME. HOW MANY MEN WOULD IT TAKE TO DO THE SAME JOBS?
4. WHY ARE ELECTROMAGNETS, INSTEAD OF PERMANENT MAGNETS, USED IN ELECTRIC MOTORS?
5. THERE ARE MANY TYPES OF ELECTRIC MOTORS. MAKE A LIST OF THEM AND HOW THEY DIFFER.

RADIO

THE 1920 PRESIDENTIAL ELECTION RETURNS...BROADCAST OVER WESTINGHOUSE RADIO STATION KDKA IN PITTSBURGH.. MARKED THE BIRTH OF REGULAR RADIO BROADCASTING.

TODAY— RADIO BROADCASTING IS A $1,500,000,000 INDUSTRY.... AND NEARLY 40,000,000 AMERICAN FAMILIES OWN ONE OR MORE RADIOS.

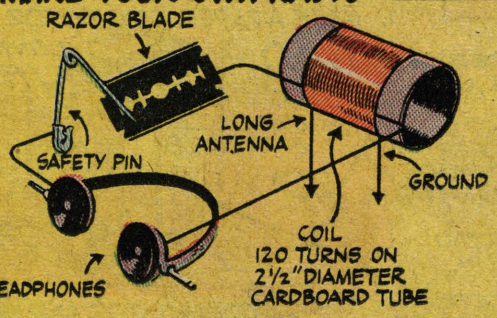
"CLEAR TO LAND ON RUNWAY 2 ZERO-OVER"

"IT'S A HIT"

RADIO IS A MAJOR LINK BETWEEN PEOPLE EVERYWHERE.

THINGS TO DO

1. MAKE YOUR OWN RADIO



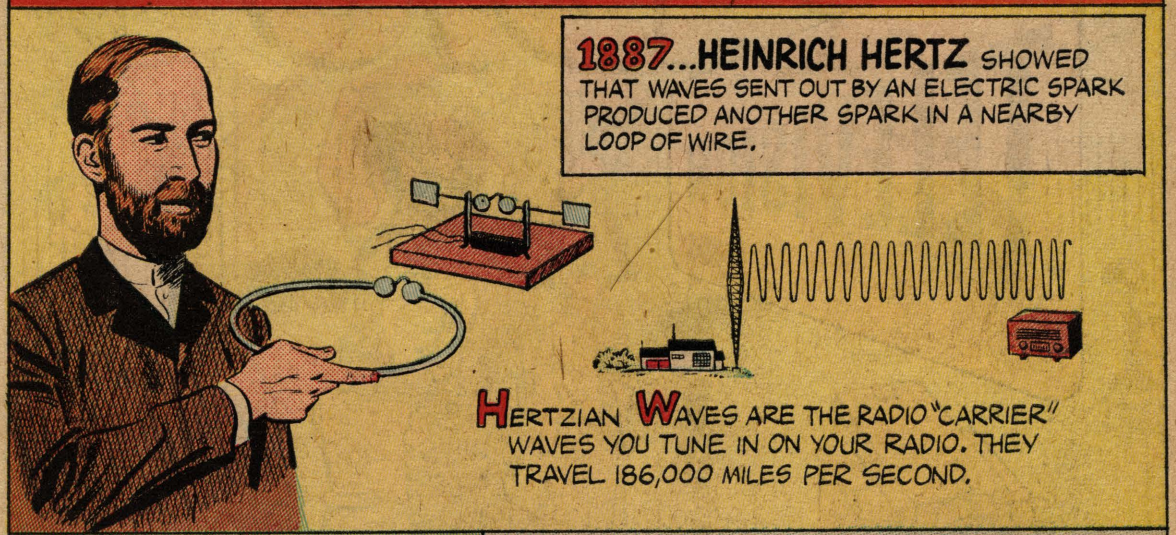
2. COLLECT PARTS OF RADIOS. MOUNT THEM AND TELL WHAT EACH IS FOR.

3. VISIT A LOCAL RADIO STATION AND SEE HOW A PROGRAM IS PUT ON THE AIR

4. FIND OUT AND EXPLAIN HOW A RADIO PROGRAM IN LOS ANGLES REACHES LISTENERS IN NEW YORK

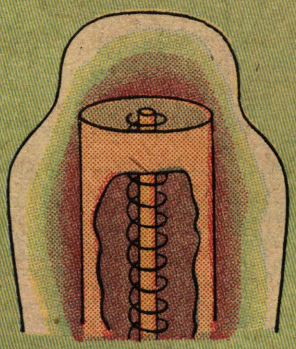
5. SOUND TRAVELS ABOUT 1100 FEET A SECOND IN AIR. HOW FAR WILL IT GO IN THE TIME IT TAKES A RADIO WAVE TO TRAVEL AROUND THE EARTH?

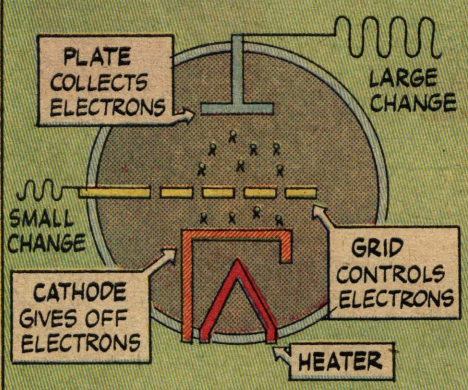
BASIC PRINCIPLES OF RADIO



1887...HEINRICH HERTZ SHOWED THAT WAVES SENT OUT BY AN ELECTRIC SPARK PRODUCED ANOTHER SPARK IN A NEARBY LOOP OF WIRE.

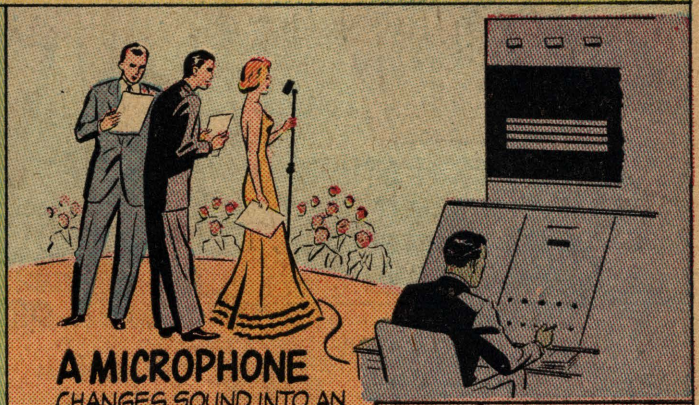
HERTZIAN WAVES ARE THE RADIO "CARRIER" WAVES YOU TUNE IN ON YOUR RADIO. THEY TRAVEL 186,000 MILES PER SECOND.





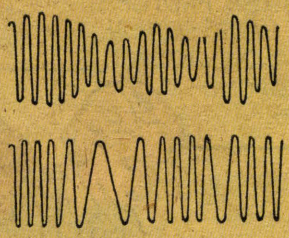
HEART OF RADIO

BROADCASTING AND RECEIVING IS THE **ELECTRON** TUBE. IT AMPLIFIES AND CONTROLS ALL KINDS OF ELECTRICAL WAVES. ELECTRON TUBES ALSO ARE NEEDED IN TELEVISION, RADAR, INDUSTRIAL ELECTRONICS, AND SCIENTIFIC RESEARCH.



A MICROPHONE

CHANGES SOUND INTO AN ELECTRICAL "AUDIO" WAVE. THIS GOES TO A TRANSMITTER WHERE IT MODULATES, OR VARIES, THE CARRIER WAVE AND IS BROADCAST.



IN **AM** RADIO... THE AUDIO WAVE CHANGES THE AMPLITUDE, OR STRENGTH, OF THE CARRIER WAVE.

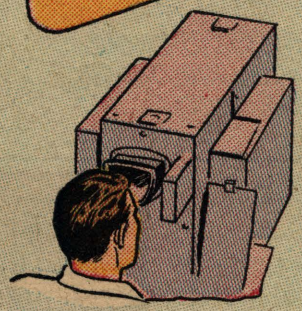
IN **FM** RADIO.. THE AUDIO WAVE CHANGES THE FREQUENCY OF THE CARRIER WAVE.

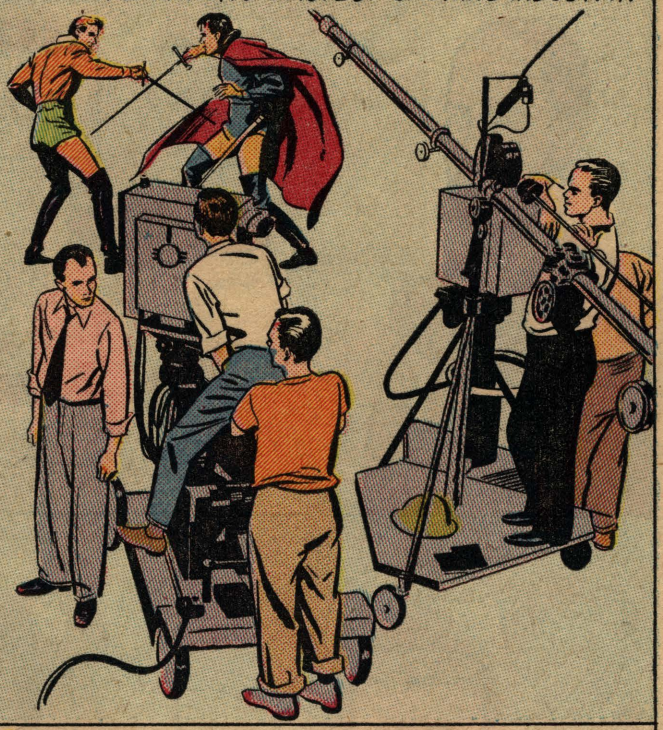
YOUR RADIO RECEIVER

SORTS OUT THE AUDIO WAVE, AMPLIFIES IT, AND FEEDS IT INTO A LOUD SPEAKER. THE SPEAKER TURNS IT BACK INTO SOUND.

TELEVISION

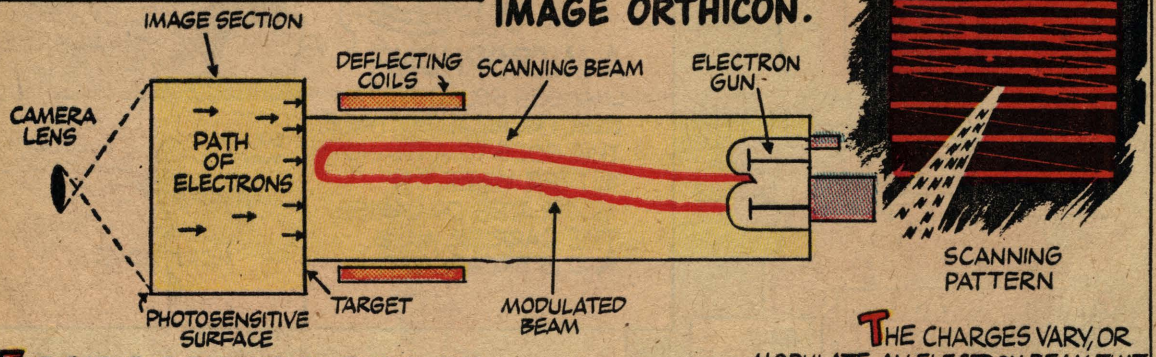
MEN WORKED MORE THAN **60 YEARS** TO PERFECT TELEVISION AND BRING IT TO THE PUBLIC. NOW IT IS THE NATION'S *FASTEST GROWING INDUSTRY.*





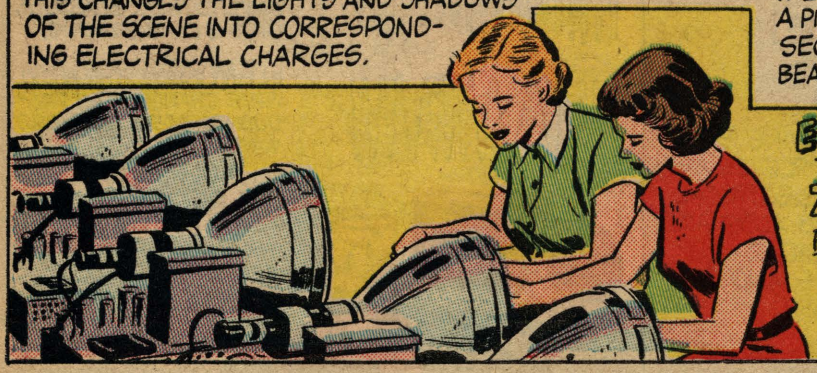
A **TELEVISION STUDIO** IS A MAZE OF BRIGHT LIGHTS, STAGE PROPS, MICROPHONES, AND CAMERAS.

IN EACH CAMERA IS AN ELECTRONIC CAMERA TUBE CALLED AN **IMAGE ORTHICON.**



THE SCENE IS FOCUSED ON THE PHOTO-SENSITIVE SURFACE OF THE IMAGE SECTION. THIS CHANGES THE LIGHTS AND SHADOWS OF THE SCENE INTO CORRESPOND-ING ELECTRICAL CHARGES.

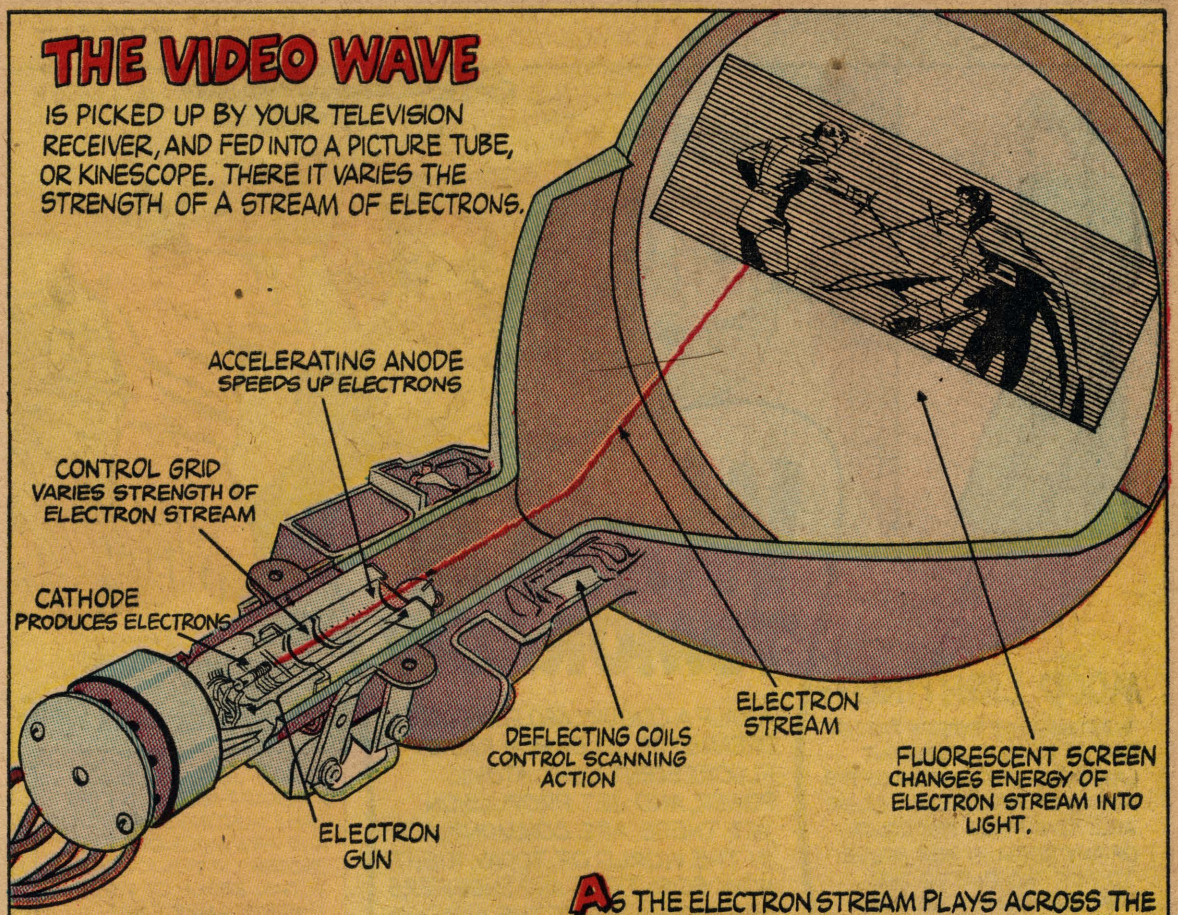
THE CHARGES VARY, OR MODULATE, AN ELECTRON BEAM THAT SCANS THE TARGET SURFACE OF THE IMAGE SECTION 525 TIMES A PICTURE—30 PICTURES A SECOND. THE MODULATED BEAM IS THE **VIDEO WAVE.**



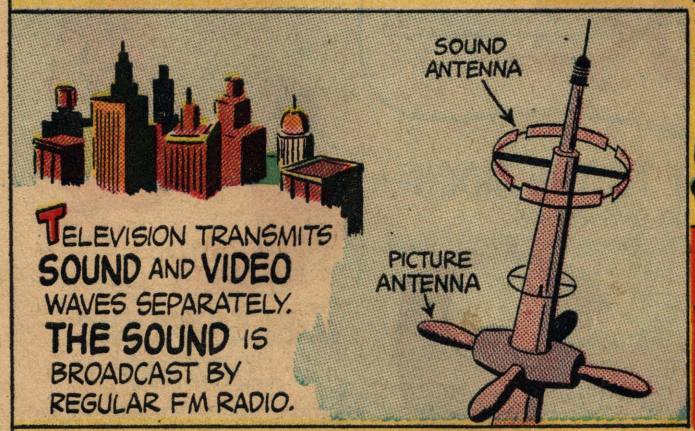
EACH OF THESE WESTINGHOUSE TELEVISION RECEIVERS HAS **750 PARTS**... MORE THAN FOUR TIMES THE NUMBER OF PARTS IN A FINE WATCH.

THE VIDEO WAVE

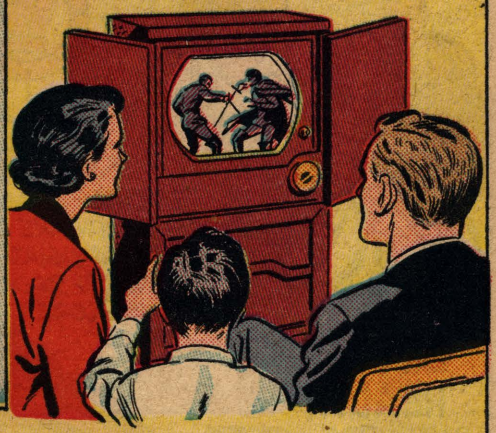
IS PICKED UP BY YOUR TELEVISION RECEIVER, AND FED INTO A PICTURE TUBE, OR KINESCOPE. THERE IT VARIES THE STRENGTH OF A STREAM OF ELECTRONS.



AS THE ELECTRON STREAM PLAYS ACROSS THE FLUORESCENT SCREEN AT THE WIDE END OF THE TUBE, IT PAINTS THE SAME PICTURE SEEN BY THE CAMERA.



TELEVISION TRANSMITS **SOUND** AND **VIDEO** WAVES SEPARATELY. **THE SOUND** IS BROADCAST BY REGULAR FM RADIO.



AT THE TURN OF A DIAL, TELEVISION BRINGS SPORTS EVENTS, PLAYS, NEWS, AND EDUCATIONAL PROGRAMS RIGHT INTO YOUR LIVING ROOM.

— THINGS TO DO —

1. COLOR TELEVISION IS MUCH LIKE BLACK AND WHITE TELEVISION. SEE IF YOU CAN FIND OUT HOW IT WORKS.
2. IF POSSIBLE, VISIT A TELEVISION STUDIO AND SEE A PROGRAM BEING TELEVISED.
3. TELEVISION ANTENNAS ARE PLACED AS HIGH IN THE AIR AS POSSIBLE. WHY IS THIS?
4. WHY IS IT NOT SAFE TO REMOVE THE BACK FROM A TELEVISION RECEIVER WHILE IT IS PLUGGED IN?
5. THERE ARE MANY USES OF PHOTO-SENSITIVE MATERIALS BESIDE TELEVISION. WHAT ARE SOME OF THEM?

World of TOMORROW

A HALF A CENTURY AGO, FEW PEOPLE DREAMED OF TELEVISION, RADIO, FLUORESCENT LIGHT, ATOMIC POWER, AND JET PROPULSION. YET THESE ARE COMMONPLACE IN THE WORLD OF TODAY. RIGHT NOW, SCIENTISTS AND ENGINEERS ARE WORKING OUT THE WONDERS OF THE WORLD OF TOMORROW.

WESTINGHOUSE SCHOOL SERVICE

MOOD LIGHTING--

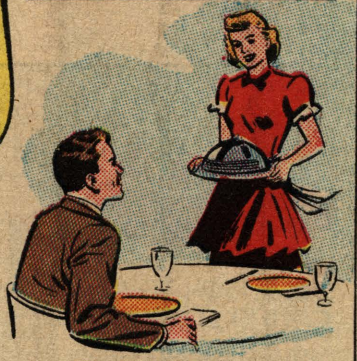
WESTINGHOUSE EXPERTS PREDICT THAT BY USING FLUORESCENT LAMPS AND SPECIAL FABRICS, THE WOMAN OF TOMORROW WILL BE ABLE TO CHANGE THE COLOR OF ANY ROOM IN HER HOUSE TO SUIT THE TIME OF THE DAY, THE SEASON, OR HER MOOD BY THE FLICK OF A SWITCH.

WEEK-END BIG GAME HUNTING

LARGE JET-PROPELLED AIRCRAFT WILL BRING BIG GAME HUNTING IN AFRICA AND SWIMMING OFF THE SHORES OF THE RIVIERA WITHIN REACH OF WEEK-ENDING AMERICANS.

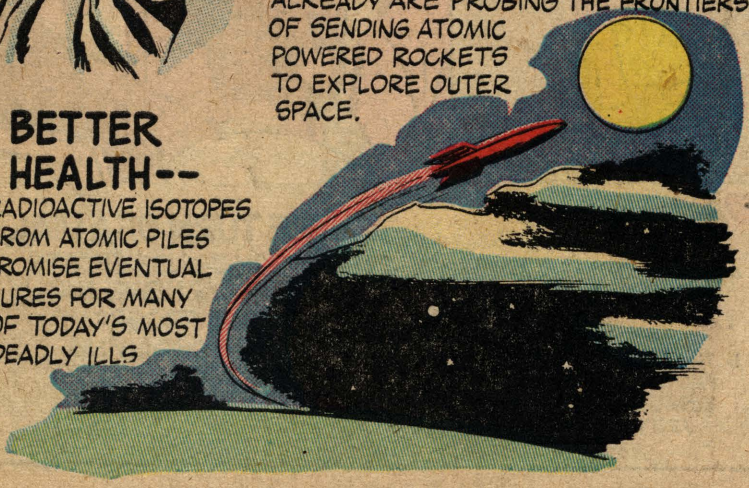
ROCKET TO THE MOON--

SCIENTISTS AND ENGINEERS ALREADY ARE PROBING THE FRONTIERS OF SENDING ATOMIC POWERED ROCKETS TO EXPLORE OUTER SPACE.



BETTER HEALTH--

RADIOACTIVE ISOTOPES FROM ATOMIC PILES PROMISE EVENTUAL CURES FOR MANY OF TODAY'S MOST DEADLY ILLS



ELECTRONIC COOKING--

ELECTRONIC COOKING--TO REDUCE THE TIME OF COOKING DINNER FROM MINUTES TO SECONDS--AND ULTRASONIC WASHING--TO CLEAN CLOTHES IN SECONDS WITHOUT A DROP OF WATER--WILL GIVE ADDED LEISURE TO THE AMERICAN HOMEMAKER.

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